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A Study of the Possible Distinction Between "Controlling Eye" and "Dominant Eye" and the Effect of Both, with Hand Dominance, on Reading Achievement.

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This longitudinal study was a replication of two disparate studies, one of dominance and one of control, which had as subjects 277 seventh- and eighth-grade pupils remaining from an original dominance study of over 500. Eye dominance was determined through hole-in-paper and V-scope; eye control at near and far point, through the telebinocular; hand dominance, through tapping, connecting dots, and a variety of performed acts; reading achievement, through the California Achievement Test; and reading differential, through a formula utilizing IQ's from the California Test of Mental Maturity. While controlling eye and dominant eye were found to be unrelated to each other, no significant difference was observed in reading achievement or reading differential regardless of the dominance or control characteristics of the subjects. A strong tendency was observed for subjects to exhibit more mixed dominance at eight grade than they had at grade 2. Finally, observing no significant difference in dominance patterns of male as compared with female subjects, the authors concluded that neither dominance nor control was a significant factor in the reading achievement of the subjects studied. A bibliography and tables are included. (Author/CM)

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A STUDY OF THE POSSIBLE DISTINCTION BETWEEN "CONTROLLING EYE" AND "DOMINANT EYE" AND THE EFFECT OF BOTH, WITH HAND DOMINANCE, ON READING ACHIEVEMENT

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Community Consolidated District #34
Glenview, Illinois
November 7, 1967

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SUMMARY

Purpose: Purposes of this study were to investigate a possible distinction between the "controlling" eye in binocular vision and the "dominant" eye used in sighting; to investigate the influence of crossed control, crossed dominance, and mixed dominance, as these related to reading achievement in a population wherein eye-hand dominance had been found unrelated to reading achievement at the third grade level; and to evaluate, at the seventh and eighth grade level, a developmental trend away from mixed dominance as reported in an earlier study which followed this same population from kindergarten to mid-third grade.

Procedures: Subjects were 267 eighth-grade and ten seventh-grade students who remained from an earlier study of over five hundred children tested in kindergarten and second grade for eye-hand dominance, and in third grade for reading achievement. Subjects were retested for the dominant eye used in sighting with the V-scope and hole-in-paper tests; for the controlling eye in binocular vision, using cards DB2-D, DB3-D, and Gray's Oral-Reading Paragraphs with the Keystone Telebinocular; for hand dominance determined by cutting, writing, throwing, eating, tapping, and connecting dots; and for reading achievement using the California Achievement Test, Form W, Level 7-9.

Chi square was used to test differences between controlling eye and sighting eye, changes in eye-hand dominance from second to eighth grade, and dominance configuration of subjects below grade level in reading as compared with those at and above grade level. The t test was used to determine significance of differences in reading achievement between crossed and mixed dominant groups as compared with the unilaterally dominant group and between the crossed control group compared with the unilateral control group.

Results: This investigation revealed a distinction between the "controlling" eye and the "dominant" eye. On the other hand, there was no significant difference in mean reading achievement or mean reading differential among children exhibiting unilateral, crossed, or mixed dominance; nor was there a significant difference in mean reading achievement or mean reading differential between groups exhibiting crossed control as compared with those having unilateral control. While no significant difference was found in dominance characteristics between male and female subjects, a definite trend was observed toward increased ambieyedness and ambidexterity from grade two to grade eight in the same subjects.

The investigator concluded that neither dominance nor control characteristics is a significant factor in reading achievement in the group examined.

I. INTRODUCTION

The Problem

The primary purpose of this study was to clarify the equivocal research on laterality and reading achievement through investigation of the possible distinction between the "controlling" eye determined through tests of binocular vision and the "dominant" eye normally referred to in studies of laterality.

A related purpose included an analysis of the relationship of crossed control, crossed dominance, and mixed dominance to reading achievement in a junior high school population wherein eye-hand dominance was earlier found to be unrelated to intelligence, reversals, reading differential, and reading achievement at the primary level.

A final purpose of this study was to evaluate, at the junior high school level, a developmental trend away from mixed dominance as reported in an earlier study which followed this same population from kindergarten to mid-third grade.

The need for such a study becomes apparent if one considers that in the past half-century, the considered causes of reading disability have increased rapidly in number and now include factors that involve nearly all phases of child make-up and life, including laterality. Further, consider that all of our young school children, irrespective of laterality, are offered generally the same method of reading instruction. If a relationship between reading disability and certain dominance or control characteristics can be determined, efforts can be expended in the search for some adjustment, alteration, or improvement in the present programs for children exhibiting such characteristics.

At present, the research literature relating eye-hand dominance to reading achievement is ambivalent. This study contributes to the literature as a replication of two disparate studies in an effort to support or deny a suggested explanation for differences in the literature. It attempts to relate the Berner explanation of the difference in research, i.e., the "controlling" eye in binocular vision is not necessarily the same as the "sighting" eye usually considered in research as the dominant eye, to the field of dominance investigations by using the eighth-grade public school population which was previously tested in third grade by Hillerich and which exhibited no relationship between hand-eye dominance and reading achievement.

Since research findings in the area of dominance and reading are not in agreement, further investigation, using knowledge and findings from previous studies, is in order.

The questions for study were established as the following hypotheses:

1. There is no significant distinction between the dominant eye used in sighting and the controlling eye used in binocular vision.

2. There is no significant difference in reading achievement between children of crossed dominance and those of unilateral dominance.

3. There is no significant difference in reading achievement between children evidencing crossed control and those with unilateral control.

4. There is no significant difference in reading achievement between children of mixed dominance and those of unilateral dominance.

5. There is no significant change in the eye-hand dominance pattern of children between second and eighth grades.

6. There is no significant difference in eye-hand dominance patterns between male and female children.

Review of Related Research

While the greatest interest in the area of dominance and reading achievement was exhibited during the 1930's, there seems to be some revival in recent years. Research is not in agreement about the relationship between eye-hand dominance and reading achievement. While a number of thoughts have been advanced, reasons for the divergence in research results have not been adequately supported.

Dearborn (16), in an address delivered before the Harvard Teacher's Association in Cambridge in 1930 and based on an extensively and authoritatively prepared case study, generalized that, in order to avoid difficulties in reading and writing, one should be either left-handed and left-eyed or right-handed and right-eyed, preferably the latter. He suggested that difficulties appeared especially in children who had "changed over" in handedness or whose "one-sidedness" had never been well established.

This same investigator co-authored with Blake (10) a study of diagnosis and treatment of reading habits among 477 freshmen attending Smith College. They summarized that right-handed and left-eyed individuals stood a greater chance of being handicapped in reading than those who were right-handed and right-eyed. It was interesting to note that, although the above generally was true, the authors found that a few of the best readers appeared to have crossed dominance or sinistral tendencies.

Teegarden (46) used as her sample some fifty children who were scattered throughout the range of 250 students entering first grade.

Handedness was determined by having the children respond to a maze problem as well as loading a "Bizzy Andy, Jr." with marbles. Eye dominance was tested with a manoptoscope. Her data revealed that consistent right dominance or left dominance, or ambidexterity with use of the right eye or left eye, were the conditions of lateral dominance most favorable to success in reading. This confirmed Dearborn's premise noted above.

Two years later Eames (19), in his evaluation of one hundred reading disability cases and a control group of one hundred unselected school children of approximately equal age and time spent in school, found that there existed nineteen per cent more mixed dominance among the poor readers. The difference, though not preponderant, implied that lateral dominance anomalies might be one of the etiological factors in poor reading.

Monroe (39) analyzed the hand and eye preference of 415 reading defectives and a control group of 101 school children. She disclosed that there existed significantly greater right-hand left-eye dominance among the retarded readers. Further, she postulated that opposite hand and eye dominance might be an impediment in the co-ordination of directional responses resulting in diverse directional preferences. However, it must be noted that the defective group differed from the control group in respects other than reading: 215 subjects in the experimental group had problems other than reading and a median I.Q. of 90.4; 155 had been referred by parents or teachers and had a median I.Q. of 100.9; the remaining forty-five were special school pupils with a median I.Q. of 77.4.

Also related to this rationale was the research of Bryngelson (13), who examined seven hundred clinical stutterers in an effort to relate lateral dominance to this speech anomaly. He declared that a lack of one sidedness was a very serious condition, based on his brief that reading and speaking had unilateral lead representation and any factor which operated against this tended to interfere with the normal establishment and development of these two functions.

Five years later this same researcher (12) published another article using similarly handicapped subjects. In comparing matched groups of seventy-eight stutterers and non-stutterers, he presented data indicating that only nineteen per cent of the stutterers were unilaterally dominant while fifty-one percent of the control group exhibited unilaterality.

Robinson (41), in 1937, published a relevant article in which she reviewed the literature prior to this time and stated her view that many investigators felt complications presented themselves when hand and eye dominance were not of the same order. Although lacking statistical evidence, she concluded that when a child exhibited these discrepant tendencies, he was likely to become confused in following reading material.

In this same year a study of two sets of twins, each set having one unilateral and one crossed-dominant member, appeared. Jenkins et al (31), in their evaluation of these subjects referred to the Institute for Juvenile Research in Chicago, declared that mixed dominance, although not an over-shadowing cause of reading disability, might present something of an obstacle.

In a more documented, statistical evaluation of 160 children referred to the Yale Clinic of Child Development because of individual adjustment problems and a control group of seventy-three cases referred for commitment to state care as dependent or neglected children, Castner (14) revealed that, at all levels, the sinistral and impartial-eyed types were relatively more frequent among the problem cases than among the controls. The atypicality of these subjects restricted and limited the degree to which one might generalize from this study.

A study of 104 backward readers was completed in 1941 by Schonell (42). Data was derived from complete case studies including information on intelligence and scholastic, emotional, physical, and environmental characteristics as well as from the results of five reading tests and an analyzation of visual perception. He presented evidence that the disability of a few backward readers was in part due to mixed eyedness and handedness, particularly a condition of left-handedness with right-eyedness.

A very thorough investigation appeared several years later, conducted by Leavell and Fults (37), in which the subjects were 192 of twenty-five hundred used by Brown in a related study of the measurement of lateral dominance. The writers equated sixteen groups of the subjects in grades two, four, and seven in terms of eye, hand, and foot dominance. These writers concluded that left dominance was less favorable to the acquisition of reading skill than was right dominance, and that crossed was least favorable.

At about this time, Hildreth (25, 26) presented a statistical evaluation of data obtained from 101 boys and ninety girls in grades kindergarten through five in which no case of reading disability was attributed to lack of learning capacity. Eye dominance was determined from the use of the Parson's Cone and the peep show test. The author revealed that of the sixteen male cases of reading disability forty-four percent exhibited mixed hand-eye dominance while fifty percent of the six females showed this condition. A total of forty-seven percent or slightly less than half of the reading disability cases showed a tendency toward mixed dominance.

In investigation of an atypical sample, having only ten per cent in the lower-middle socio-economic class and none lower, Stevenson (44) identified two outstanding characteristics of her poor readers as being mixed eye-hand preference and personal or emotional problems. Also included from the data collected from these accelerated achievers having a median Stanford-Binet I.Q. of 130, was the proposal that mixed eye-hand preference might tend to make reading more difficult, especially in

in the early stages.

In a later investigation, this author collaborated with Robinson (45) in a study of all sixty-one children attending the senior kindergartens at the University of Chicago Laboratory School and evidencing the same atypicality mentioned above. They found that bright pupils were not handicapped in learning to read, even if their hand and eye preference differed from right consistency. This study was motivated by their earlier revelation that dominance anomalies did disadvantage the poor readers at the early stages of reading.

Wilson and Leavell (49) conducted a study of 749 school age children and postulated that deficiencies in the language arts manifested themselves significantly in more instances where hand-eye confusions or visual imagery reversals or both were present than was true of cases where such anomalies were not found. They found crossed dominant groups were lowest in both oral and silent reading.

A team of medical investigators, including two ophthalmologists and a registered nurse, studied 250 children referred because of a reading problem and found ninety-three had various conditions of crossed dominance with the remaining 157 exhibiting incomplete laterality (5). These children, who were of normal intelligence and who had been exposed to good teaching procedures, were very exhaustively and extensively examined by Benton for eyedness, both monocularly and binocularly, through eleven reliable tests. The fact that all 250 subjects were found to have had crossed eye-hand dominance or a greater than normal amount of retinal rivalry, a condition that the investigators interpreted as a lack of proper eye dominance, must be tempered by the consideration that a clinical approach was used with these excessively retarded readers.

This medical team, after directing treatment at overcoming binocular conflict and establishing strong unilaterality of hand and eye, reported that, after a period of from six months to five years, eighty-seven percent showed improvement.

In reviewing the studies presented heretofore, it appeared that lack of right dominance was most often associated not only with problems of reading, spelling, and speech but also with emotional instability and other factors. It certainly was apparent that there existed a tendency among investigators to relate reading disability to crossed dominance, usually of right-hand and left-eye.

Conversely, a substantial number of studies were found available in the literature, nearly equivalent in quantity and quality, which suggested a lack of relationship between reading and laterality.

Bond and Tinker in their review of the literature on dominance and reading presented this view by stating that "the role of lateral dominance in reading disability is a controversial issue. The literature on the subject is extensive and largely equivocal." (11)

In support of a lack of relationship was the study by Fendrich (20) in which he carefully matched groups of second and third grade public school children, each containing forty seven boys and seventeen girls. In this carefully controlled investigation, the groups differed in reading achievement with the experimental group being retarded at least one-half grade. This author identified no significant difference between the groups in terms of handedness, eyedness, or mixed dominance.

In comparing 316 reading-disabled students with 245 unselected public school controls, Harris (24) identified no relationship between reading and either eye or hand dominance although the clinical group exhibited greater mixed-hand dominance at age seven. This writer accounted for the unusually large number of mixed-handed children, one-fifth of the control group and one-third of the experimental group, by his statement that his tests were sensitive. Fourteen tests of handedness were used, many of which might have been influenced by social pressures.

Anderson (1) offered a carefully done case study of a fifteen-year-old boy stutterer with spelling disability. She identified no positive relationship between dominance and reversals or reading disability. It was her feeling that, when reading or reversal errors have been found, a diagnosis has often been made on that basis without further study of causative factors.

Witty and Kopel (50) carefully matched two groups of children in grades three, four, five, and six as to intelligence, age, and grade placement. The experimental group was at least one semester below the grade level norms while the control group had reading scores equivalent to or above their grade level norms. Although handedness was determined solely by questionnaire, they found no relationship between reading ability and handedness or reading ability and eyedness. Further, they found that right, left, or mixed ocular-manual dominance occurred no more frequently among reading problems than among non-problems.

Very similar results were disclosed by Gates and Bond (22) in the same year. A group of sixty-five retarded readers with a mean age of 8.61 years were matched with a group of normal readers equivalent in age, intelligence, number of years in school, and socio-economic background, and were examined for handedness, eyedness, and visual acuity. The data obtained from groups of first grade pupils, older normal readers, and older reading problems showed no consistent tendency for eye dominance, hand dominance, or any combination of these to be related to reading achievement, word pronounciation, reversal errors, or visual perception. Handedness testing was again of a type affected by social pressures.

In close harmony was the study by Wolfe (51), whose aim was to compare a group of male retarded readers with a like number of average readers on laterality of function in order to determine a primary or contributing relationship to reading disability. Her subjects were eight and nine year olds, of normal intelligence, who were from unilingual

American-born families of middle socio-economic status. She concluded that eye dominance, hand dominance, and hand-versus-eye dominance were not related in a primary way to reading disability of the degree represented in her subjects.

Johnston (32) carefully tested the handedness (with eleven tests) and the eyedness (with ten tests) of more than one hundred public school children nearly thirteen years of age. He revealed that "any observed association between anomalies of lateral dominance and reading disability can be explained on the basis of fluctuation due to the operation of chance factors."

Kirk (34), in a study of sixty-one "high grade" mentally defective subjects, found no significant differences between pure and mixed laterality on the Gray Oral Reading Test.

Ihinger (28, 29) investigated the possibilities of differential achievement in reading, arithmetic, and language among 2,446 sinistral, bilateral, mixed lateral, and dextral school children of both sexes. Inasmuch as the writer observed no consistent difference in achievement with laterality classification as a variable, he concluded that lateral preference was not a cogent factor in determining levels of academic achievement.

Leavell and Beck (36) categorized thirty-eight white male elementary-school pupils as to hand-eye dominance and compared them with respect to their ability to identify symbols tachistoscopically presented in the right and left visual fields. The groups were equated as to chronological age, I.Q., and reading quotient. These writers identified no significant difference between the unilateral and the mixed dominance groups, although the inferior readers in both groups were superior in the left visual field.

In 1963, Hillerich (27) reported a four-year study which began with 722 public and parochial school kindergartners in Glenview, Illinois. The investigator determined eye dominance with the V-Scope and Hole-in-paper test and hand dominance with tests of motor skill and tapping. His subjects, numbering four hundred at the termination of this study in third grade, were placed in one of five dominance categories. The author found no significant differences among the five dominance categories in mean reading achievement, mean reading differential, mean intelligence, or mean reversal test scores. Likewise, he identified no significant difference in the percentage of mixed, crossed, or unilaterally dominant children in a group of below average readers as compared with a group scoring average or above in reading. This study did disclose a tendency toward greater unilaterality in hand-eye dominance among second graders as compared with their dominance characteristics in kindergarten, thereby suggesting a developmental trend.

This same investigator commented that earlier studies which reported a relationship between dominance and reading disability were generally clinical studies while most of those reporting no relationship were usually studies of public school children.

Belmont and Birch (4), two years later, also noted this possible cause for the ambivalence in related research. They reported that their results on lateralization differed from those of other investigators who studied retarded readers selected from a clinical setting, but were similar to those drawn from children in community samples. These researchers, using as subjects two hundred nine- and ten-year-old boys attending school in Aberdeen, Scotland, found no reliable difference in lateral dominance between a group of retarded readers and a group of normal controls. They also concluded that the amount of mixed laterality was not distinguishable between the two groups.

Two studies appeared in 1966. One dealt with a group of thirty-eight male and twenty female mental retardates by Capabianco (15). He found that handedness and eyedness, at least for the mentally retarded population, bore no relationship to reading achievement and seemingly related negatively to performance which demanded word recognition in traditional and mirror-image presentations.

The report by de Hirsh et al (17) was largely informal and stemmed from twenty years experience with preschool children referred to the Pediatric Language Disorder Clinic of Columbia-Presbyterian Medical Center for a variety of oral language deficits. Although an extraordinarily large proportion of these children developed reading, writing, and spelling difficulties several years later, de Hirsh suggested that ambiguous lateralization at the age of between five and one-half and six and one-half years was not significantly correlated with their performance. Two-thirds of the children had settled on a preferred hand in kindergarten; those who had a preferred hand did not read or spell better at the end of second grade than those whose handedness had not been established.

As has been suggested, there appeared a dichotomy between the studies drawing samples from clinical setting and those drawing from normal school populations. This review offers reinforcement and support for that thesis.

Other possibilities for confusion or discrepancies among research are the differences in operational definitions of laterality, the various instruments and tests used to determine or measure laterality, intelligence, or achievement, and discrepancies in age, socio-economic background, geographic location, and type of problem of the subjects investigated.

Another possible explanation for the confusion or discrepancy in the research has been specified by several investigators. The most effective and conclusive of these were Berner and Berner (6) who, in 1938, declared that there existed a crucial difference between the controlling eye and the sighting eye, the latter being the one identified as the dominant eye in most research.

It was their opinion that when binocular vision had developed,

there remained one visual act which was essentially monocular. This was the act of sighting. The sighting eye was established in early life, remained stable and was called the dominant eye. As biocularity gave way to binocularity, it became habitual to use both eyes for visual perception. The eye that controlled the rivalry within the pattern of binocular vision they termed the controlling eye and, according to them, the other eye played an assisting role rather than an equal one. The authors suggested that the controlling eye was not necessarily the eye with which one sighted. Further, the writers felt that whereas the dominant eye was stable from early life, the controlling eye could be shifted because the binocular pattern which initiated one's motor reactions, speech, reading, and writing, was easily influenced by changes in vision or could be controlled by training (7).

Their investigations have led them to believe that when the controlling eye, not the sighting eye, was on the side opposite that of handedness, difficulties in reading ensued. They concluded that crossed control always caused some visual motor disability which could be relieved by training that succeeded in producing corresponding control.

These investigators joined with two colleagues to offer support for their thesis by making an investigation of crossed control at the Devereaux School, a residential treatment center in Devon, Pennsylvania (8). Their results were presented in a paper to the 1963 convention of the American Association for Mental Deficiency (9).

Support for Berner and Berner's premise was found in an article by Fink (21) in 1938. He stated that the two eyes did not affect the visual consciousness with equal force; one eye led the other. He referred to this leading eye as the dominant eye.

In harmony with the above report were two that appeared in the literature at about the same time. Updegraff (47) and Lund (38) both reported the lead movement of one eye in binocular visual activity.

Delacato (18) indicated that in the first months of life an infant was biocular in visual performance, using only one eye at a time. At approximately seven to nine months of age he started to use his eyes in concert and here began binocularity, with stereopsis in vision developing at about one year. It was at this point that the controlling eye began to develop.

Warren and Clark (48) stated that there was no justification for the belief that the "sighting eye" was preferred, dominated, or assumed leadership in normal binocular vision, although such a belief was often expressed.

Spache (43) strongly supported Berner and Berner's contention that there was a fallacy inherent in the presumption that the eye indicated as preferred in monocular tests was necessarily the eye given preference in binocular situations. He declared that there existed no obvious reason why there should be a marked relation between the eye chosen to look through a cone or to sight a gun and the reading achievement of the

same eye.

The most supportive study of Berner's thesis was that offered by Leavell (35). He gave credence to Berners' theories and offered case studies to support the remediation of pupils with crossed-control problems. This worker using the Keystone Hand-Eye Coordinator has offered effective therapy in the elimination of reversals and concomitant frustrations, with resultant improvement in the functional skills of the several language arts.

It seems apparent from the ambivalence in reported literature that urgent, well-controlled research efforts are needed with normal school populations to further investigate whether or not differences do in fact exist between the sighting eye and the controlling eye and their relationship, with handedness, to reading disability.

Procedures

The Sample

Subjects of this study were 267 eighth-grade and ten seventh-grade students who remained from an earlier study by Hillerich (27) of four hundred children tested in kindergarten and second grade for eye-hand dominance and in third grade for reading achievement. The children attended the Glenview Junior High School, Our Lady of Perpetual Help Parochial School, and St. Catherine Laboure Parochial School, all in Glenview, Illinois.

Since, in the earlier study, the pupils had four different teachers during the four years of the study and in the intervening years they were assigned each year to different teachers, it has been assumed that the teacher variable was nullified.

Pupils were not moved on to subsequent grades as intact classes; little attempt was made to maintain original groupings. In all instances, from kindergarten testing through the intervening years to the final testing in eighth grade, placement of pupils in classes was as heterogeneous as possible.

Selection of Tests

The tests for the dominant eye, the controlling eye, and the dominant hand were selected and interpreted in terms of the reported Berner and Berner (8) and Hillerich (27) studies so that the two studies could be accurately replicated as well as defensibly related to each other. The dominance tests used by Hillerich in the earlier study and repeated in this current effort were selected on the basis of reliability as reported by other investigators and on the basis of suitability for the age level being tested.

V-Scope.- One of the most popular tests for eyedness has been the Manuscope or a modification of this instrument known as the V-Scope (11). As used in the earlier study, the latter was a cardboard tube about eight inches long and wide enough to contain both eyes at one end, while tapering to an opening of about one inch in diameter at the distant end. The same V-Scope was used in the current investigation. The tube had the advantage of requiring the utilization of both hands to hold it open, so that the influence of the dominant hand was nullified.

Hole-in-paper.- This test made use of a seven-inch square of tagboard, containing a one-inch hole in the center. The subject looked through the hole with both eyes open, while holding the square with both hands at arm's length.

Tapping.- One test for manual dominance was a modified tapping test. Tapping avoided the danger of social pressure, but unless an electric stylus was used, scoring became subjective. Considering this, a typewriter was used on which the key B was marked in red. Ten seconds of tapping with each hand comprised one testing. The hand which tapped the greater number of B's was considered dominant. Both speed and accuracy were important in determining handedness, since handedness is both a qualitative and a quantitative phenomenon. This typewriter and the method of its use was identical to that used in the earlier Hillerich study.

Cutting, Writing, Throwing, Eating, Hammering, Batting, and Kicking.- In an effort to completely replicate the testing procedures of the Berners, each subject performed the manual operations of cutting with a scissors, writing his name, throwing a ball, handling eating utensils, kicking a falling object, striking a spike with a simulated hammer, and assuming a batting stance.

Connecting Dots Test.- A replica of the Connecting Dots Test appears in this study as Appendix 3. Each subject was given two copies of this test; one used for the right hand and one for the left hand. It consisted of nine horizontal rows of paired dots that had to be perfectly joined by as many penciled lines as was possible to complete in forty-five seconds.

Test of Reading Achievement.- The reading section of the California Achievement Test, Form W, Junior High Level, was administered to determine the reading achievement of the subjects. The choice of the tool was made based on the prior use of the Upper Primary Level of the same test with these subjects in the third grade.

Test of Intelligence.- The California Short Form Test of Mental Maturity was administered to determine intelligence. A group test was selected by Hillerich since this was the type of instrument usually available to, and used by, public school personnel. This specific group test was chosen because of its relationship to the reading test used.

The Keystone Telebinocular.- The Keystone Telebinocular was used to determine the controlling eye in binocular vision as was true in the Berners' investigation. The controlling eye at binocular far-point vision was determined by the use of the Keystone test cards DB-1D, DB-2D, and DB-3D as viewed with the Telebinocular. The controlling eye at binocular near-point reading distance was determined by use of Gray's Oral-Reading Paragraphs, i.e., cards DG-9, DG-10, and DG-11, with the Telebinocular.

Administration of Tests

All tests of dominance, both ocular and manual were administered by the principal investigator as hereafter described.

V-Scope.- The examiner stood about ten feet in front of the subject who had been given the scope to hold with both hands. The student was asked to "look through the tube with both eyes open and guess what I am holding in my hand." While the interest of the child was centered on a small object held by the examiner near the examiner's own eyes, the latter could plainly see which eye was used by the subject, since the non-dominant eye was hidden by the tube. Five trials or identical repetitions of this test were given to each subject.

Hole-in-paper-. Because of the possibility of error in relying on a report of the subject, the investigator had to observe the eye used. Instructions to the subject were: "Hold this cardboard with both hands as far from your face as possible. Now, please attempt to fit my face in this small hole. Remember, keep both eyes open." The examiner then moved approximately ten feet away and signaled the subject to raise the tagboard. As with the V-Scope, five trials were given to each subject.

Tapping.- The subject was seated squarely before a typewriter and told he must race to note the number of times he could hit the painted B center key. The choice of preferred hand was his. One practice test was allowed and followed by two closely-timed tests of ten seconds for each hand. In cases of unclear choice or question, a third test was administered.

Connecting Dot Test.- Each subject was requested to draw a penciled line perfectly connecting two dots arranged in vertical pairs along horizontal rows. Instructions included the caution to pass the penciled line between the two dots and that if one of the dots was not touched, it was not considered as completed. An example of the desired maneuver was demonstrated by the examiner on a chalk board. After the subject chose the hand he preferred and was given practice opportunity, he was allowed forty-five seconds to successfully join as many of the nine horizontal rows of paired dots as was possible. This completed, he then repeated this test with the opposite hand.

Cutting, Writing, Throwing, Eating, Hammering, Batting, and Kicking.- In a further effort to measure manual dominance, each subject

was given instructions to perform manual operations of a routine nature, i.e., cutting a piece of paper with a scissors, writing his name on one of the tests, throwing a small ball to the examiner, mimicking the operation of several eating utensils available to the subject, striking a pencil with a simulated hammer, assuming a batting stance as the investigator pantomimed a pitching delivery, and kicking a falling object. Each of these operations was completed before other handedness tests were attempted, so knowledge of the purpose was denied the subject.

To assure an exact replication of the Berner study, the Berner technique for determining the controlling eye in binocular vision was used. D. E. Berner served as a consultant and trained the investigator in the exact methods and scoring used in the earlier study.

The instrument used in this testing was the Keystone Telebinocular with six test slides or cards, all of which were manufactured by the Keystone View Company, Meadville, Pennsylvania.

Each subject was tested individually in a quiet place where he was free from distractions and where other persons could not hear his responses. The examiner used a stop watch and charted the subject's responses on the appropriate Record Forms. The Telebinocular and table were adjusted for each subject to assure a comfortable posture.

If prescriptive lenses were worn constantly by the subject from arising until bedtime, testing for controlling eye was made with lenses. If the child wore glasses for classroom and/or reading only, evaluation of far-point vision was made without glasses and near-point reading was tested with glasses. Finally, if glasses were worn "sometimes" but never consistently by the pupil, all evaluations were accomplished without glasses. These standards for examining pupils with prescriptive lenses were identical to those used by the Berners in making their evaluations of controlling eye.

Controlling Eye Near-Point Reading.- Using the Keystone Telebinocular, the subject was shown three slides or cards of the Standardized Gray Oral Reading Check Tests, which allowed the child to display the efficiency of each eye, and of both eyes together, in the act of reading. The examiner measured speed and quality of reading in terms of elapsed time and number of errors. While the subject read, a record was made of the elapsed time in seconds. A continuing record of each error was also made on the Record Form.

The examiner gave each subject the instructions which appeared in the manual provided with the test. "I want you to read this story out loud to me. Begin reading when I say 'begin.' If you find some hard words, read them as well as you can without help and continue reading. Now, begin!"

Controlling Eye Far-Point Reading.- Far point was the equivalent of an actual distance of twenty feet. Cards were again presented with

the Keystone Telebinocular. Each subject was expected to display the efficiency of each eye and both eyes together in distant vision. The Examiner very carefully followed the relevant instructions appearing in the manual provided with the Telebinocular.

Standardized Tests.- The California Short-Form Test of Mental Maturity was administered by the classroom teachers in accordance with the instructions in the manual accompanying those tests.

The California Achievement Test, "Reading Section," was administered by the principal investigator to all subjects.

Schedule for Testing.

Tests used in this investigation were administered to the subjects as outlined in Table 1.

Organization of the Data.

The eye-dominance battery consisted of five trials with the V-Scope and five trials with the hole-in-paper test. If fewer than eight of the ten trials at a given level were consistent, the subject was considered as having mixed-eye dominance.

Hand dominance test results were recorded in terms of a score for the right hand and a score for the left hand. In the tapping test this score was the total number of B's typed with the given hand, regardless of whether the subject had two or three trials. With the dot test, the score for each hand was the number of dots actually connected with the penciled line.

Following Hillerich's procedure, raw scores on each of the two handedness tests above were converted to ratio scores.[1] On each of these two handedness tests, the total group was then divided into a left-inclined group with ratio scores of forty-nine and below and a right-inclined group with ratio scores of fifty-one and above. Mean and standard deviation were computed separately for the right-inclined and the left-inclined group. Any subject exceeding one and one-half standard deviations from the mean in the direction of ambidexterity was considered mixed-handed and was included with the subjects who scored exactly fifty. Finally, results of both handedness tests had to be in agreement or the subject was classified as mixed-handed.

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[1]The formula used was: $\left(\frac{R}{R+L}\right) 100$, where R was the raw-score of the right hand and L was the raw score of the left.

Table I

Testing Schedule for Determining the Controlling Eye, the Dominant Eye, Manual Dominance, and Reading Achievement.

Purpose of Test	Name of Test	Number of Trials	Criteria	Test Replicated
Controlling Eye Far Point	DB-1D	Practice test	Not considered	Berner
	DB-2D	1	Compare score for each eye	Berner
	DB-3D	1	Compare score for each eye	Berner
Controlling Eye Near Point	DG-9	1	Compare rate and errors	Berner
	DG-10	1	Compare rate and errors	Berner
	DG-11	1	Compare rate and errors	Berner
Dominant Eye	V-Scope	5	8/10=clear right or left	Hillerich
	Hole-in-paper	5		
Dominant Hand	Cutting	1		
	Writing	1	3/4=clear right or left	Berner
	Throwing	1		
	Eating	1		
	Tapping	3/hand	Converted to ratio scores	Hillerich
	Connecting Dots	45 sec/hand	Converted to ratio scores	Hillerich
Reading Achievement	Calif. Ach. Test	1	Grade equivalent	Hillerich

As a further measure of manual dominance, the subject was given one trial of cutting, writing, throwing, eating, hammering, batting, and kicking. Placement in the left control group was made if major motor activity employed the operation of the left hand, and in the right control group if the right hand carried on the major motor activity. There was crossed control when major motor activity was employed on both sides of the body. Assessments were based on hand use, not preference.

Subjects, on the basis of dominance test results, were grouped into three dominance categories: unilaterally dominant, crossed dominant, and mixed dominant, which included all subjects who were unclear in eye dominance, hand dominance, or both eye and hand dominance.

Scoring of the tests for the controlling eye resulted in placing subjects in one of three categories of control: left-corresponding control, right-corresponding control, or crossed control, which included all subjects who exhibited (1) lesser binocular efficiency for distant vision in the eye on the side of major motor use, (2) lesser binocular efficiency in the act of reading on the side of major motor use, or (3) significant ambidexterity.

Efficiency for distant vision in each eye was measured by percentage points, four being deducted for a completely missed response and two deducted for a corrected response. Speed of response, when markedly different in either eye, was also a consideration. When one eye scored six or more percentage points lower than the other, it was designated as the less efficient eye.

Near-point efficiency in each eye was determined by adding the seconds of elapsed reading time to the number of reading errors, including reversals. When one eye scored nine or more points higher than the other, it was considered to be the less efficient.

Those subjects who displayed visual problems, such as convergent vision, alternating vision, or monocular vision, were placed in a special category and were not included in any statistical comparisons.

These categories and cut-off points were established by the Berners in their research.

In addition to a total reading achievement score, a reading differential score was desired in which the factor of intelligence could be held constant. This score was determined by computing the subject's chronological age as of the testing month. Then the I.Q., based on the California Test of Mental Maturity, was used to compute reading expectancy by means of the formula used by Hillerich.[1] Subtracting actual

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[1] $\frac{A+3(CA \times IQ)}{4} - 5$

reading achievement from reading expectancy yielded the reading differential, plus or minus, for each subject.

Treatment of the Data.

Significance of difference between the controlling eye and the sighting eye was determined by chi square. Change in eye-hand dominance from second to eighth grade was also evaluated by chi square. Likewise, this statistical method was used to determine differences in eye-hand dominance patterns between male and female children.

Subjects were grouped into three dominance categories: unilaterally dominant, crossed dominant, and mixed dominant. Significance of difference in mean reading achievement and mean reading differential among the three dominance groups was determined by t test.

A similar grouping, in terms of unilateral control and crossed control, allowed comparison of both reading achievement and reading differential for these groups. Again significance of difference in mean reading achievement and in reading differential was determined by t test.

As a further check against differences among laterality groups, subjects were divided into two groups, those at and above grade level and those below grade level in reading achievement. Significance of difference in dominance characteristics and control characteristics of the two groups was determined by chi square.

To assure accurate replication of the Berners' study in terms of the Keystone testing, Mrs. Berner, who did the testing in that study, served as a consultant in training the investigator in use of the telebinocular. To ensure accurate replication of his research, Dr. Robert L. Hillerich trained the investigator in the use and interpretation of the dominance tests administered to the subjects in kindergarten and second grade.

II. RESULTS

The purposes of this study were to investigate a possible distinction between the controlling eye in binocular vision and the dominant eye used in sighting, and to investigate the relationship between both hand-eye dominance and control characteristics with reading achievement and reading expectancy. A corollary investigation was made of a possible developmental trend away from mixed dominance as reported in an earlier study which followed the same population from kindergarten to mid-third grade.

Determination of Dominance

To determine eye dominance, the V-scope and hole-in-paper tests were administered five times each in kindergarten, in grade two, and again in grade eight. A minimum of eight of the ten responses were arbitrarily designated as establishing clear eyedness. Fewer than eight consistent preferences were considered an indication of unclear or mixed eyedness. While the rank order of each of the dominance characteristics was the same, there was a marked increase in the percentage of ambi-eyedness or mixed-eyedness in eighth grade at the expense of both right-eyedness and left-eyedness. This data would tend to remove support from Berner's contention that the dominant eye used in sighting is developed shortly after birth and does not change throughout the growth and development of each individual unless altered by trauma. Table II shows the results of the eye dominance tests.

Table II

Results of Eye Dominance Tests

Dominant Eye	Kindergarten		Grade 2		Grade 8	
	Number	Percent	Number	Percent	Number	Percent
Right	232	58.00	240	60.00	148	54.21
Left	136	34.00	142	35.50	67	24.54
Mixed	32	8.00	18	4.50	58	21.25
Total	400	100.00	400	100.00	273	100.00

Hand dominance was tested in kindergarten, in grade two, and again in grade eight by means of a modified tapping test, using the B key on a typewriter. In grades two and eight, the connecting dots test was also administered to the subjects. In the case of both hand-dominance tests, raw scores were converted to ratio scores by means of the formula used by Hillerich in his study.[1] A ratio score of fifty represented exact equality of hand skill or ambidexterity. Subjects with ratio scores above fifty were considered right-inclined and those with scores below fifty were considered left-inclined. In the case of both the right-inclined group and the left-inclined group, one and one-half standard deviations from the mean in the direction of a score of fifty was established as the cut-off point between clear and mixed handedness. Handedness on both tests had to be in agreement or the subject was classified as mixed handed or ambidextrous. Results of the distribution of the ratio scores are reported in Table III.

Table III

Distribution of Ratio Scores
on Grade Eight Handedness Tests

Lateral Group	Tapping			Connecting Dots		
	Mean	S.D.	Cut-off	Mean	S.D.	Cut-off
Below 50	46.7	4.6	Below 50	40.92	4.24	Below 47
Above 50	52.83	1.26	Above 51	60.29	4.32	Above 54

The range of ratio scores was quite narrow on the tapping test, and a good deal wider on the connecting dots test as indicated in Table IV. The connecting dots test appeared to be the better test for the determination of handedness because the factors of both accuracy and speed were more clearly involved.

An examination of Table V evidenced that the decrease in percentage of right-handed children from kindergarten through grade two has continued through grade eight, while the percentage of ambidextrous children continued the increase that was noted between kindergarten and grade two. This would seem to make untenable Hillerich's observation that the increase noted in grade two was primarily the result of the inclusion of the connecting dots test.

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[1] Ratio score = $\left(\frac{R}{R+L}\right) 100$, where R was the raw score for the right hand and L was the raw score for the left hand.

Table IV

Cut-offs For Handedness Tests at Grade Eight
Based on Hillerich's Criteria

Test	Left-Handed	Ambidextrous	Right-Handed
Tapping Test	0-49	50-51	52-100
Connecting Dots Test	0-46	47-54	55-100

Table V

Results of Hand Dominance Tests

Dominant Hand	Kindergarten		Grade 2		Grade 8	
	Number	Percent	Number	Percent	Number	Percent
Right	330	82.50	304	76.00	121	44.32
Left	41	10.25	31	7.75	22	8.06
Mixed	29	7.25	65	16.25	130	47.62
Total	400	100.00	400	100.00	273	100.00

Table VI shows the number and percentages of subjects in each dominance group in the three grades tested. Decreases that were evident from kindergarten to grade two in the unilateral and crossed dominant categories have continued into grade eight. The two mixed dominance categories which had shown a percentage increase from kindergarten to grade two continued their growth. The three other mixed dominance categories which had decreased slightly in grade two reversed this trend and displayed a noticeable increase in grade eight. These changes were the result of an increase of both mixed eyedness (Table II) and mixed handedness (Table V).

Table VI

Number and Percentage of Children
in Each Dominance Group
at Kindergarten, Grade Two, and Grade Eight

Eye-Hand Dominance	Kindergarten		Grade 2		Grade 8	
	Number	Percent	Number	Percent	Number	Percent
Right - Right	197	49.25	187	46.75	75	27.47
Left - Left	17	4.25	15	3.75	8	2.93
Right - Left	17	4.25	12	3.00	6	2.20
Left - Right	112	28.00	105	26.25	29	10.62
Right - Mixed	18	4.50	41	10.25	67	24.55
Left - Mixed	7	1.75	22	5.50	28	10.26
Mixed - Mixed	4	1.00	2	0.50	33	12.09
Mixed - Right	21	5.25	12	3.00	17	6.22
Mixed - Left	7	1.75	4	1.00	10	3.66
Total	400	100.00	400	100.00	273	100.00

The final grouping of subjects, divided in terms of sex and based on the Hillerich dominance tests in grade two, together with the results from grade eight, is reported in Table VII. This data more emphatically presents the increase in the mixed dominant category from second to eighth grade, at the expense of a decrease in percentage of subjects in various unilateral and crossed dominance categories. There was an increase of 35.1% in mixed dominant subjects while the greatest decrease was in the unilaterally right dominant group with a loss of nearly 19%.

Table VII

Eye-Hand Dominance of Subjects
in Grade Two and Grade Eight

Eye-Hand Dominance		Number			Percent
		Boys	Girls	Total	
R-R	Grade 2	87	100	187	46.75
	Grade 8	34	41	75	27.47
L-L	Grade 2	6	9	15	3.75
	Grade 8	5	3	8	2.93
R-L	Grade 2	4	8	12	3.00
	Grade 8	4	2	6	2.20
L-R	Grade 2	48	57	105	26.25
	Grade 8	14	15	29	10.62
Mixed	Grade 2	44	37	81	20.25
	Grade 8	65	90	155	56.78

The Dominant Eye and the Controlling Eye

A problem was encountered in attempting to identify the distinction between the dominant eye used in sighting and the controlling eye used in binocular vision. While Hillerich presented very definite cut-offs to distinguish the dominant eye characteristics, thereby allowing a definite placement to be made, no such definite cut-offs were suggested by the Berners for determination of the controlling eye. The Berners' interest was in unilateral or crossed control with no allowance for a mixed controlling-eye category. Therefore, in evaluating the first hypothesis, this investigator was forced to make the following determinations of the controlling eye: subjects were considered as having right controlling eye if (1) there was no difference between the eyes on near and far point and the subject was right handed, or (2) if both eye tests favored the right eye; subjects were considered as having

left controlling eye if (1) there was no difference between the eyes on near and far point and the subject was left handed, or (2) if both eye tests favored the left eye; subjects were considered to have mixed eye-control if a subject demonstrated preference for opposite eyes on the two tests.

A data analysis was conducted to determine whether or not a distinction existed between the dominant eye and the controlling eye. The chi square test of significance was chosen. The region of rejection consisted on the values of chi square which had a probability associated with occurrence of .05 or less under the null hypothesis.

The dominant eye and controlling eye groups were established in three categories, in each of which the actual number of right-eyed, left-eyed, and mixed-eyed subjects were compared to an expected frequency based on a hypothesis of independence. Results are presented in Table VIII.

Table VIII

Computation of Chi Square
to Determine Distinction
Between Dominant and Controlling Eye

Observed Frequency (fo)		Expected Frequency (fe)		fo - fe		$(fo-fe)^2/fe$ ratios	
Dominant Eye	Controlling Eye	Dominant Eye	Controlling Eye	Dominant Eye	Controlling Eye	Dominant Eye	Controlling Eye
147	152	149.5	149.5	- 2.5	2.5	0.042	0.040
66	31	48.5	48.5	17.5	-17.5	6.314	6.314
60	90	75.0	75.0	-15.0	15.0	3.000	3.000

df = (3-1) (2-1) = 2 $\qquad$ $x^2 = 18.712$

The value for chi square was found to be 18.712. The table for values of chi square revealed that the probability associated with obtaining a value as large as the observed value was better than .001 for two degrees of freedom with a two-tailed test. As a result, the first null hypothesis was rejected at the .05, .01, and .001 levels in favor of the research hypothesis: there is a significant distinction between the dominant eye used in sighting and the controlling eye used in binocular vision.

Crossed Dominance and Reading Achievement

Subjects' reading achievement was based on the total reading score of the California Achievement Test administered in grade 8.2. The significance of difference in mean reading achievement between the group of crossed dominant and unilaterally dominant subjects was determined by the *t* test. The *t* tests in this study were based on the assumption that two independent random samples were taken from normal populations whose variances were not necessarily equal. The Smith-Satterthwaite test was used to test the null hypothesis.

Table IX

A Comparison of Differences in Mean Reading Achievement Between the Crossed Dominant Group and the Unilateral Dominant Group

Dominance	Number	Reading Achievement in Grade Equivalent		*t*	*t* .05
		Mean	Variance		
Crossed	35	9.8971	2.2579	0.1527	1.96
Unilateral	83	9.8518	1.9557		

Table IX presents a calculated *t* value of 0.1527 which, when compared to a table of *t*, using a degree of freedom of 60.05, was less than 1.96. This test indicated acceptance of the null hypothesis at the .05 level: there is no significant difference in reading achievement between children of crossed dominance and those of unilateral dominance.

The comparison of mean reading achievement above did not consider the influence of intelligence, per se. To minimize this influence a reading differential was computed by deducting each subject's reading achievement from an expected achievement based on his I.Q. A comparison of mean reading-differential scores between the crossed dominant and unilateral groups is shown in Table X.

The degree of freedom for this comparison was 54.3873 which offered a table value of 1.96 at the .05 level. When this was contrasted to the computed value of 0.7715, it revealed no significant difference in mean reading differential scores for the crossed dominant group when compared with the unilateral dominant group.

Table X

A Comparison of Differences in Mean Reading Differential
Between the Crossed Dominant Group
and the Unilateral Dominant Group

Dominance	Number	Reading Differential in Grade Equivalent		t	t .05
		Mean	Variance		
Crossed	35	0.3257	1.1449	0.7715	1.96
Unilateral	83	0.1674	0.7766		

Crossed Control and Reading Achievement

The t test was also used to determine the significance of difference between the group of crossed control subjects as contrasted with the unilateral control group. Results are presented in Table XI.

Table XI

A Comparison of Differences in Mean Reading Achievement
Between the Crossed Control Group
and the Unilateral Control Group

Control	Number	Reading Achievement in Grade Equivalent		t	t .05
		Mean	Variance		
Crossed	101	9.7227	2.1561	-1.7436	-1.96
Unilateral	172	10.0348	1.8390		

The computed t of 1.7436 reported above was less than the table value of 1.96 at the .05 level of significance using the degree of freedom 196.43. This test resulted in the retention of the null hypothesis: there is no significant difference in reading achievement between children of crossed control and those with unilateral control.

Again, to obviate the influence of subjects' I.Q., the data in Table XII, based on reading differential, was submitted to analysis by t test.

Table XII

A Comparison of Differences in Mean Reading Differential
Between the Crossed Control Group
and the Unilateral Control Group

Control	Number	Reading Differential in Grade Equivalent		t	t .05
		Mean	Variance		
Crossed	101	.2703	1.0381	1.1057	1.96
Unilateral	172	.1290	1.0381		

The t value above resulted in the acceptance of the premise that differences in mean reading differential between the two control groups were not significant at the .05 level using a degree of freedom of 209.64.

Mixed Dominance and Reading Achievement

An effort was made to determine the difference in both mean reading achievement and reading differential for children exhibiting mixed dominance as contrasted with those of unilateral dominance by use of the t test. Results follow as Table XIII.

Table XIII

A Comparison of Differences in Mean Reading Achievement
Between the Mixed Dominant Group
and the Unilateral Dominant Group

Dominance	Number	Reading Achievement in Grade Equivalent		t	t .05
		Mean	Variance		
Mixed	155	9.9607	1.9383	0.5731	1.96
Unilateral	83	9.8518	1.9557		

The two-tail t test analysis, using a degree of freedom of 167.07, revealed that the mixed dominant group did not significantly differ in mean reading achievement from the unilateral group at the .05 level of

significance. The null hypothesis was retained: there exists no significant difference at the .05 level between mixed and unilaterally dominant groups in terms of mean reading achievement.

To remove the influence of I.Q. on results, reading differential scores were computed. The comparison of mixed and unilaterally dominant pupils, in terms of reading differential, is reported in Table XIV. The *t* .05 value was determined using a degree of freedom of 197.52.

Table XIV

A Comparison of Differences in Mean Reading Differential Between the Mixed Dominant Group and the Unilateral Dominant Group

Dominance	Number	Reading Differential in Grade Equivalent		*t*	*t* .05
		Mean	Variance		
Mixed	155	0.1536	1.1506	-0.1075	1.96
Unilateral	83	0.1675	0.7766		

An analysis of the data provided by Tables XIII and XIV necessitated the acceptance of the fourth hypothesis at the .05 level: there was no significant difference in reading achievement between children of mixed dominance and those of unilateral dominance.

In a further effort to discover a possible relationship between dominance and reading achievement as presented by the second, third, and fourth hypotheses, all subjects who scored below their grade norm of 8.2 were compared, in terms of percentages in each dominance group, with the percentages in those same dominance groups of subjects who scored at or above grade level. The results are reported in Table XV.

Table XV reveals a slight tendency for subjects below grade level in reading achievement to represent a larger percentage of crossed dominance when compared to those above grade level, while the above-grade-level subjects exhibit a greater percentage of mixed dominance. Chi square was used to determine the significance of this finding. The three dominance groups reported in Table XV were established as three categories, in each of which the actual number of subjects below grade level was compared with those at or above grade level.

Table XV

Eye-Hand Dominance of Subjects Below Grade Level
in Total Reading Score
Compared with the Dominance of Subjects
At or Above Grade Level

Dominance	Below 8.2		At and Above 8.2	
	Number	Percent	Number	Percent
Unilateral	11	32.35	73	30.04
Mixed	17	50.00	139	57.20
Crossed	6	17.65	31	12.76
Total	34	100.00	243	100.00

Table XVI revealed a chi square of .885 which compared to 5.991, the value given in the chi square table for the .05 level of significance at a degree of freedom of 2, indicated no significant difference in the groups.

Table XVI

Computation of Chi Square
to Determine Difference in Dominance
Between Subjects Below Grade Level in Total Reading Score
Compared with the Subjects At or Above Grade Level

Observed Frequency (fo)		Expected Frequency (fe)		fo - fe		$(fO-fe)^2/fe$ ratios	
At or Above Grade Level	Below	At or Above Grade Level	Below	At or Above Grade Level	Below	At or Above Grade Level	Below
73	11	73.7	10.3	-.7	.7	.007	.047
139	17	136.9	19.1	2.1	-2.1	.032	.230
31	6	32.5	4.5	-1.5	1.5	.069	.511

df = (3-1) (2-1) = 2 x^2 = .885

Dominance Difference Between Children in Second and Eighth Grade

The results of a statistical analysis of the data relating to the fifth hypothesis, i.e., that there is no significant difference in the eye-hand dominance pattern of children between second and eighth grade, would lack reliability without an evaluation of the dominance characteristics of subjects who were dropped from the second grade population as a result of the relocation of family residences. A comparison of subjects dropped and those retained in the study at eighth grade, in terms of dominance characteristics as tested at grade two, is presented in Table XVII.

The greatest disparity shown in the table below existed in the right-mixed dominance group, which offered a difference in percentage between subjects remaining and those dropped of only 5.41.

Table XVII

Eye-Hand Dominance Characteristics
of Grade Two Subjects
who Remained in the Grade Eight Study
as Compared to Those Dropped From the Study

Eye	Hand	Total in Grade Two	Subjects Remaining	Subjects Dropped	Remaining: Percent in each category	Dropped: Percent in each category
Right	Right	187	132	55	47.65	44.72
Right	Left	12	5	7	1.81	5.69
Right	Mixed	41	33	8	11.91	6.50
Left	Left	15	6	9	2.17	7.32
Left	Right	105	76	29	27.44	23.58
Left	Mixed	22	15	7	5.41	5.69
Mixed	Mixed	2	2	0	0.72	0.00
Mixed	Right	12	5	7	1.81	5.69
Mixed	Left	4	3	1	1.08	0.81
Total		400	277	123	100.00	100.00

As further evidence of the similarity of both groups, Table XVIII lists the percentages in each of the three dominance categories under consideration.

Table XVIII

Comparison of Unilateral, Crossed, and Mixed Dominant Groups in Terms of Percentage Dropped or Retained from the Original Grade Two Study

Dominance	Remaining: Percent in each category	Dropped: Percent in each category
Unilateral	49.82	52.04
Crossed	29.25	29.27
Mixed	20.93	18.69
Total	100.00	100.00

Tables XVII and XVIII indicated that, while the optimum condition of the presence of all second grade subjects in grade eight was not in existence, the percentage of subjects dropped was reasonably in keeping with the percentage remaining in the study, thereby obviating the concern that subjects remaining in grade eight were not a true sample of the original population from grade two.

The decrease in mixed eyedness between kindergarten and grade two, as reported by Hillerich, was found to reverse itself in grade eight, and the mixed handedness increase reported by the same author showed a rapid acceleration in grade eight, as noted in Tables II and V respectively.

The three dominance groups reported in Table XV were established as three categories in each of which the same children, both as second grade subjects and eighth grade subjects, were compared with an expected frequency to determine whether or not dominance characteristics of these subjects had changed. Results of this comparison are reported in Table XIX.

As reported in Table XIX, the computed chi square of 72.255 was regarded as extremely significant and the hypothesis of no difference between the two groups in terms of dominance characteristics must be rejected at the .001 level.

Table XIX

Computation of Chi Square
to Determine the Difference in Dominance Characteristics
Between Grade Two and Grade Eight

Observed Frequency (fo)		Expected Frequency (fe)		fo - fe		$(fo-fe)^2/fe$ ratios	
Second Grade	Eighth Grade	Second Grade	Eighth Grade	Second Grade	Eighth Grade	Second Grade	Eighth Grade
136	83	109.5	109.5	26.5	-26.5	6.433	6.433
59	155	107.0	107.0	-48.5	48.5	21.533	21.533
78	35	56.5	56.5	21.5	-21.5	8.181	8.181

df = (3-1) (2-1) = 2 $\qquad x^2 = 72.255$

Dominance Differences Between Male and Female Subjects

A generally accepted premise has been that because female students are more apt than male subjects to engage in small muscle activity, they are also more likely to establish handedness earlier and more firmly. This prompted the effort to determine a relationship between the eye-hand dominance patterns of boys and girls.

Chi square was used to test the significance of difference. The three dominance groups reported in Table XV were again established as three categories in which the actual number of male and female subjects was compared. Results are reported in Table XX.

Rejection of this sixth hypothesis required a chi square of greater than 5.991 to be significant at the .05 level with two degrees of freedom. The chi square of 1.296 is considerably less than significant, leading to acceptance of the hypothesis: there is no significant difference in the eye-hand dominance patterns of male and female children.

Table XX

Computation of Chi Square
to Determine the Difference in Dominance Characteristics
Between Male and Female Students in Grade Eight

Observed Frequency (fo)		Expected Frequency (fe)		fo - fe		$(fo-fe)^2/fe$ ratios	
Male	Female	Male	Female	Male	Female	Male	Female
39	44	37.092	45.908	1.908	-1.908	0.098	0.079
65	90	69.267	85.733	-4.267	4.267	0.263	0.212
18	17	15.641	19.359	2.359	-2.359	0.356	0.287

df = (3-1) (2-1) = 2 $\qquad$ $x^2 = 1.296$

III. CONCLUSIONS AND RECOMMENDATIONS

Purpose and Procedures

A total of 277 subjects were included in this investigation of a possible relationship between hand-eye dominance and control characteristics in regard to reading achievement and reading differential. Corollary investigations were made of the possible distinction between the controlling eye in binocular vision and the dominant eye used in sighting, and of a developmental trend away from mixed dominance as reported in an earlier study which followed this same population from kindergarten to mid-third grade.

Subjects were administered two eye-dominance tests, the V-scope and the hole-in-paper test, in grade eight. The controlling eye was determined at both far-point and reading distance by the use of the Keystone Telebinocular.

A modified tapping test and a connecting dots test were administered. Further determination of handedness was made by observing the subjects in the act of writing, throwing, eating, hammering, batting, and kicking.

The California Short-Form Test of Mental Maturity was used to determine the reading expectancy, and the California Achievement Test assessed reading achievement.

On the basis of the tests for control, the subjects were divided into three groups: unilateral control, crossed control, and visual problems. Using the dominance tests, subjects were placed into three groups also: unilateral dominance, mixed dominance, and crossed dominance.

The *t* test was used to determine significance of differences in reading achievement and reading differential between crossed and mixed dominant groups as compared with the unilaterally dominant group and between the crossed control group as compared with the unilateral control group.

Chi square was used to identify differences in dominance configurations of subjects below grade level in reading as compared with those at and above grade level. Significance of differences between the controlling eye and the dominant eye was determined by Chi square as were changes in eye-hand dominance from second to eighth grade. Chi square was also used to determine the differences in eye-hand dominance patterns between males and females.

Findings

As a result of this investigation, the following hypotheses failed

to be rejected at the .05 level:

1. There is no significant difference in reading achievement between children of crossed dominance and those of unilateral dominance.

2. There is no significant difference in reading achievement between children evidencing crossed control and those with unilateral control.

3. There is no significant difference in reading achievement between children of mixed dominance and those of unilateral dominance.

4. There is no significant difference in the eye-hand dominance patterns between male and female children.

The following hypotheses were rejected at the .05 level:

1. There is no significant distinction between the dominant eye used in sighting and the controlling eye used in binocular vision.

2. There is no significant change in the eye-hand dominance pattern of children between second and eighth grades.

Interpretation

Any study of laterality is weakest at its very base: the tests used to determine laterality are not conclusively validated. In this study, tests were selected which had been used in earlier studies by Hillerich and by Berner.

The rejection of the first hypothesis, comparing dominant eye status of subjects with that of their controlling eye, was based on this investigator's subjective identification of the controlling eye as determined by the Berners' general description of control. The Berner research determined the general control status but did not present cut-offs for determination of the controlling eye specifically. Recognizing this limitation, this investigator found a significant difference (.001) between the controlling eye classification and that of dominant eye: the tests measure different characteristics.

Rejection of the second hypothesis was based on the findings regarding both eye and hand dominance: a significant change in eye-hand dominance pattern occurred between grade two and grade eight.

Use of the tapping test and connecting dots test replicated from Hillerich's study, supported the brief that handedness is a matter of degree, ranging from exact equality of hands to extreme differences in skill with the right or left hand. Based on Hillerich's tests, right

handed subjects decreased in number by 31.68 percent from grade two to grade eight, and ambidextrous subjects increased by nearly the same amount. This finding is in opposition to the premise that the dominant hand develops rather early in life and strengthens in preference thereafter. This trend toward ambidexterity might be explained by the fact that as children grow and develop, they actually become less dependent upon their dominant hand and motor activity becomes more diversified. This greater diversification of motor activity may have resulted in the increase of children in the ambidextrous category.

Using the V-scope and the hole-in-paper test to determine eye dominance, there was identified a marked increase in the percentage of mixed eyedness in grade eight at the expense of right-eyed and left-eyed subjects. This data would tend to remove support from Berner's contention that the dominant eye used in sighting is developed shortly after birth and does not change throughout the life of each individual unless altered by trauma.

The dominance testing in eighth grade indicated that twenty-seven percent of the population were unilaterally right dominant, while slightly better than half were in the mixed dominant category. These findings were rather inconsistant with those of other investigators because of the emphatic increase in mixed dominant subjects.

The suspicion that a longitudinal study might disclose a trend away from mixed dominance was not confirmed by this study. In comparing the results of dominance testing in grade eight with those in grade two, the investigator found that the mixed dominance category showed an increase of ninety-six and the unilaterally dominant group a decrease of fifty-three. This removed support from the prediction of Hillerich, based on his identification of a decrease of mixed eyedness between kindergarten and second grade, that a further decrease might be noticed in these subjects by grade eight.

A possible limitation was apparent in the longitudinal aspect of this study. The sample used was only a part of the original population tested in kindergarten and second grade, with 277 subjects remaining from the original number of 400. The effect of this limitation was diminished when subjects remaining in the study were compared with those transferred by grade eight. The percent of subjects in each dominance category revealed that the grade eight sample was representative of the original grade two population.

It was established by Hillerich that a larger percentage of boys was mixed dominant and below grade level in reading. This fact suggested a possible explanation for the relationship found by some other investigators between mixed dominance and reading disability: usually studies reporting a relationship between these two factors were studies of boys. This thought prompted the investigation of possible differences in eye-hand dominance patterns between males and females in grade eight.

Although it seems probable that boys, because of the more varied and more gross physical activity, were later in developing established

handedness, analysis of the data evidenced that the differences were not significant at the eighth grade level. This finding would suggest that slower development of handedness in boys and their comparative lack of readiness to begin reading may have no other relationship than co-existence.

It was readily apparent that in the sample investigated, dominance was not a significant factor in reading achievement. The factor of intelligence was obviated by the finding that differences in reading differential between the dominance groups were not significant. This result is consistent with the earlier findings of Hillerich in the original population from which these subjects came.

Further support and reinforcement for this conclusion came from the determination that the dominance configuration of subjects below grade level in reading did not differ significantly from that of subjects at or above grade level.

Control characteristics were also found to be non-significant factors in both reading achievement and reading differential. This finding is contrary to findings of the Berners that crossed control was an extremely significant and causative factor in reading disability. As a possible explanation for this discrepancy, it is noted that Berners' results were based on retarded readers in a clinical setting while the sample for this study was drawn from a normal school population, an explanation suggested by Hillerich for the same discrepency in the literature on dominance and reading.

While the group of 277 subjects was a sufficiently large sample, other factors might have had a limiting effect on this study. The subjects were generally well above the national norms in both reading achievement and intelligence. Furthermore, their home and school environments were academically richer than average. While these factors had no apparent effect on dominance itself, the question arises as to whether the better background helped to overcome some presumed handicap of dominance.

Recommendations

As a result of findings reported in this study, the following recommendations are suggested:

1. There exist many areas for research into causes of reading disability which could prove more fruitful than the areas of dominance or control.

2. Probative efforts should be made into the effect of the decussation of the optic nerve allowing the right retinal fibers of both eyes to terminate solely in the right cerebral hemisphere and the left retinal fibers of both eyes to terminate solely in the left hemisphere. Disquisition of this

rarely referred to neurological phenomonon might discredit future dominance research.

3. This study offered evidence of definite changes in dominance status over a nine year period. Other longitudinal studies could contribute to the research by verifying this trend and by identifying changes in control as well as dominance status.

4. This study suggested a disagreement between clinical and public school studies in relating dominance and control characteristics to reading disability. Other studies might use a different approach to investigate this divergence further.

5. Visual acuity has been discounted in previous research as a measure of eye dominance. A question might be raised regarding the visual acuity of a given eye and its role of control in binocular vision.

IV. REFERENCES

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2. Barbe, Walter B., Virginia Cannaway, and Thelma Williams, "Factors Contributing to Reading Difficulties," School and Society, Vol. 85, No. 2117, October 12, 1957, pp. 265-266.

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3. Barger, William C., "An Experimental Approach to Aphasic and to Non-Reading Children," American Journal of Orthopsychiatry, Vol. 23, January 1953, pp. 158-170.

   A school psychologist of the Board of Education, City of New York, drew inferences from a number of case studies of aphasics and non-readers. Limited by the number of subjects.

4. Belmont, Lillian and Herbert G. Birch, "Lateral Dominance, Lateral Awareness, and Reading Disability," Child Development, Vol. 36, No. 1, March 1965, pp. 57-71.

   This was a report of research on a public school population in Aberdeen, Scotland, in which laterality was not found to be significantly related to reading disability.

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   Two ophthalmologists and one registered nurse examined 250 children with reading disability and normal intellectual endowments for abnormalities of their binocular function and eye-hand dominance. They found all subjects with either crossed eye-hand dominance or with greater than normal retinal rivalry.

6. Berner, George E. and Dorothy E. Berner, "Reading Difficulties in Children," Archives of Ophthalmology, Vol. 20, November 1938, pp. 829-838.

   In an investigation of more than five hundred patients, the two authors revealed a difference between the dominant eye used in monocular vision and the controlling eye in binocular vision. They suggested that it was the controlling eye which, when on the side opposite the dominant hand, resulted in difficulty in learning to read. Important to this study.

7. --------, "Relation of Ocular Dominance, Handedness, and the Controlling Eye in Binocular Vision," A.M.A. Archives of Ophthalmology, Vol. 50, November 1953, pp. 603-608.

The authors treated 353 patients with crossed control by shifting their eye control to the side of their dominant hand. Improvement in reading skills was reported in each instance.

8. Berner, George E., Dorothy E. Berner, Walter M. Uhler and Marguerite B. Horn, A Clinical Investigation of Crossed Control in a Residential Treatment Center, a printed report of the Devereaux Schools, Devon, Pennsylvania, The Devereaux Schools, 1963, 1-14 pp.

The clinical observation of 750 children with family-academic problems resulted in the declaration that treatment of crossed control in the Berner manner leads to improved academic achievement and general progress.

9. Berner, George E., Dorothy E. Berner, Walter M. Uhler and Marguerite B. Horn, Treatment of Visual and Visual Motor Problems in the Mentally Deficient, a paper presented at the Eighty-Seventh Annual American Association for Mental Deficiency, Devon, Pennsylvania, The Devereaux Schools, 1963, 1-10 pp.

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12. Bryngelson, Bryng, "Laterality of Stutterers and Normal Speakers," Journal of Social Psychology, Vol. 2, February 1940, pp. 151-155.

An association between speech defectives and sinistrals and/or ambidextrousness was identified. A very noticeable relationship was discovered between lack of unilaterality and stuttering when comparing matched groups of seventy-eight young adults. Findings were based on an atypical population.

13. --------, "Sidedness as an Etiological Factor in Stuttering," Journal of Genectic Psychology, Vol. 47, No. 1, September 1935,

pp. 204-217.

This author, after examining seven hundred clinical stuttering patients, found the lack of one-sidedness a very serious condition as writing, speaking, and reading have unilateral lead representation. As was true with his later study reported above, the sample used was atypical.

14. Castner, Burton M., "Handedness and Eyedness of Children Referred to a Guidance Center," The Psychological Review, Vol. 3, No. 8, June 1939, pp. 99-112.

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15. Capobianco, R.J., "Ocular-Manual Laterality and Reading in Adolescent Mental Retardates," American Journal of Mental Deficiency, Vol. 70, No. 5, March 1966, pp. 781-785.

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16. Dearborn, Walter F., "The Nature of Special Abilities and Disabilities," School and Society, Vol. 31, No. 799, May 10, 1930, pp. 632-636.

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19. Eames, T. H., "The Anatomical Basis of Lateral Dominance Anomalies," American Journal of Ophthalmology, Vol. 4, October 1934, pp. 524-528.

Mixed dominance was found to be more common among one hundred reading disability cases than among one hundred unselected school cases, both groups of equal age and time spent in school.

20. Fendrick, Paul, Visual Characteristics of Poor Readers, New York, Bureau of Publications, Teachers College, Columbia University, 1935, 1-55 pp.

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21. Fink, W. H., "The Dominant Eye: Its Clinical Significance," A.M.A. Archives of Ophthalmology, Vol. 19, No. 9, April 1938, pp. 555-582.

This study included an early description of the operation of the dominant eye in binocular vision. This work was an important basis of Berners' contribution, replicated in this study.

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Data obtained from 242 first graders, older normal readers, and older reading problems, connoted no consistent tendency for eye dominance, single eye superiority in acuity, hand dominance, or any combination thereof to be related to reading achievement or reversals.

23. Harris, Albert J., How to Increase Reading Ability, New York, Longman's Green and Co., 1961, pp. 249-260.

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24. --------, "Lateral Dominance, Directional Confusion, and Reading Disability," Journal of Psychology, Vol. 44, Second Half, October 1957, pp. 283-294.

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25. Hildreth, Gertrude H., "Development and Training of Hand Dominance," Journal of Genetic Psychology, Vol. 76, First Half, March 1950, pp.39-100.

It was reported that strengthening hand dominance aided in the adjustment of some children as old as ten or twelve, but not with older students. Greater unilaterality was found among non-stutterers.

26. --------, "A School Survey of Eye-Hand Dominance," Journal of Applied Psychology, Vol. 29, No. 1, February 1945, pp. 83-88.

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27. Hillerich, Robert L., A Study of the Relationship Between Eye-Hand Dominance and the Reading Achievement of Selected Primary Pupils, unpublished doctoral dissertation, Colorado State College, 1962, x-108 pp.

This was a four-year study of four hundred primary school students disclosing no significant difference in the percentage of mixed, crossed, or unilaterally dominant children in a group of below average readers as compared with a group scoring average or above in reading. A longitudinal study.

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The author referred to his earlier investigation, wherein, among 2,446 sinistral, bilateral, mixed lateral, and dextral school children, no consistent differences in achievement with the laterality factor as a variable were revealed.

29. --------, "Some Relationships Among Laterality Groups at Three Grade Levels of Performance on the California Achievement Tests," in Toward a Professional Identity in School Psychology, Los Angeles, California Association of School Psychologists and Psychometrists, 1963, pp. 70-74.

This study investigated the possibilities of differential achievement in reading, arithmetic, and language among 2,446 sinistral, bilateral, and dextral school children to determine changes in interrelationships among these groups in grades three, five, and seven. Lateral preference was not found to be a cogent factor in academic achievement.

30. Jansky, Jeannette, "A Case of Severe Dyslexia with Aphasia-like Symptoms," Reading Teacher, Vol. 15, No. 2, November 1961, pp. 110-113.

A case study of a twelve and one-half year old boy referred to the Language Disorder Clinic, Columbia Presbyterian Medical Center, was imparted. It was revealed that laterality was not firmly established.

31. Jenkins, D.L., Andrew W. Bacon and Laura Elemendorf, "Mixed Dominance and Reading Disability," American Journal of Orthopsychiatry, Vol. 7, No. 1, January 1937, pp. 72-81.

This was a consideration of two sets of girl twins referred to the Institute for Juvenile Research, Chicago. The evidence indicated that confusion of right and left orientation with mixed dominance may present something of an obstacle to learning to read.

32. Johnston, Philip W., The Relationship of Certain Anomalies of Vision and Lateral Dominance to Reading Disability, monograph of the Society for Research in Child Development, Vol. 2, No. 2, Serial No. 32, Washington, Society for Research in Child Development, 1942, 147 pp.

The investigator reported the reliability of comprehensive tests of handedness and eyedness administered to more than one hundred public-school children. He disclosed that dominance and reading were not related.

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The consideration was presented that if ambiguous dominance does exist, problems with spatial and directional orientation are present in some degree and are reflected in language development. Not a statistical evaluation.

34. Kirk, Samuel A., "A Study of the Relationship of Ocular and Manual preferences to Mirror Reading," Journal of General Psychology, Vol. 44, 1934, pp. 192-205.

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The author presented case studies to support his claim that use of the Hand-Eye Co-ordinator to remediate pupils' crossed-control problems was an effective therapy in the elimination of reversals with resultant improvement in the functional skill of language.

36. Leavell, Ullin W. and Harry S. Beck, "Ability of Retarded Readers to Recognize Symbols in Association with Lateral Dominance," Peabody Journal of Education, Vol. 37, No. 1, July 1959, pp. 7-14.

Thirty-eight elementary school pupils with reading problems were categorized as to hand-eye dominance and placed into three groups. There were no significant differences in I.Q. or reading ratio between unilateral and mixed dominance groups. Contestable results based on the few subjects in each subgroup.

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The purpose of this investigation was to relate lateral dominance to displacement of visual imagery in space, natural tendencies in directional movement, and reading achievement in 192 subjects from a population of 2,500 used in a related study of lateral dominance.

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This article described the method of investigating reading difficulties which was used in the Orthogenic School of the University of Chicago. This school served as a lab for the study of deficiencies in learning and of maladjustments in behavior. A complete discussion of causes of reading disability.

42. Schonell, Fred J., "The Relationship of Reading Disability to Handedness and Certain Ocular Factors," British Journal of Educational Psychology, Vol. 10, November 1940, p. 227-234; Vol. 9, Part 1, February 1941, pp. 21-27.
The writer found evidence that the disability of a few backward readers was in part due to their mixed eyedness and handedness, and that left-handedness, per se, was not a cause of reading disability but could be a contributing factor.

43. Spache, George D., "Eye Preference, Visual Acuity, and Reading Ability," Elementary School Journal, Vol. 43, No. 9, May 1943, pp. 539-543.
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44. Stevenson, Lillian P., "Poor Readers in the Lower School of the Laboratory Schools," in Clinical Studies in Reading I, Supplementary Educational Monographs, No. 68, Chicago, The University of Chicago Press, June 1949, pp. 7-25.
This study, based on eye-hand dominance and reading tests given to an above average socio-economic school population, revealed that the two outstanding characteristics of poor readers were mixed eye-hand preference and personal or emotional problems. An atypical sample.

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47. Updegraff, Ruth, "Ocular Dominance in Young Children," The Psychological Bulletin, Vol. 29, No. 9, November 1932, pp. 654.

This investigation of 190 children using an adaptation of the Miles A-B-C Vision Test, revealed that for many subjects ocular dominance is not established before the age of three; thereafter it is commonly found.

48. Warren, Neil and Brant Clark, "A Consideration of Use of the Term Ocular Dominance," Psychological Bulletin, Vol. 35, No. 5, May 1938, pp. 298-304.

These investigators found no justification for the often-expressed belief that the sighting eye is preferred, dominates or assumes leadership in normal binocular vision.

49. Wilson, Grace E. and Ullin W. Leavell, A Study of the Relation of Functional Neurological Dominance to Reading Difficulties in Selected Cases of the McGuffey Reading Clinic, unpublished study, school of Education, University of Virginia, 1954, 159 pp.

This study of 749 school-age children disclosed that deficiencies in language arts manifested themselves significantly in more cases where hand-eye confusions or reversals or both were present.

50. Witty, Paul and David Kopel, "Factors Associated with the Etiology of Reading Disability," Journal of Educational Research, Vol. 29, February 1936, pp. 449-459.

The authors' study of one hundred public school students disclosed data indicating little, if any, relationship between reversal errors and mixed hand-eye dominance. The validity of a questionnaire for handedness is doubtful.

51. Wolfe, Lillian S., "Differential Factors in Specific Reading Disability: I. Laterality of Function," Journal of Genetic Psychology, Vol. 58, First Half, March 1941 pp. 45-56.

The author in this study of thirty-six eight- and nine-year-old boys connoted that eye dominance, hand dominance, and hand versus eye dominance are not related in a primary way to reading disability.

V. APPENDIX

Definitions of Terms

Laterality: eye-hand preference. This term is used synonomously with dominance. As a generic term it refers to bodily behavior characterized by the unilateral preference of the external bipartite organs.

Unilateral dominance: the preferred hand and eye are on same side of the body: right-eyed and right-handed or left-eyed and left-handed.

Crossed dominance: the preferred hand and eye are on opposite sides of the body: right-eyed and right-handed or left-eyed and left-handed.

Mixed dominance: no clear preference is indicated for hand or eye, either singly or together: ambi-eyed and right or left-handed, or ambidextrous and right or left-eyed.

Sighting eye: the eye that is the preferred eye in a monocular or sighting act. In this study the sighting eye is synonomous with the dominant eye.

Controlling eye: In binocular vision the two eyes are used as a unit for visual perception. Both eyes do not play an equal role but there is a rivalry and one eye controls the binocular perception while the other plays an assisting role. One consistently leads or controls in these situations in which there must be a choice between two images.

Corresponding control: the controlling eye and preferred hand are on the same side of the body: right controlling-eye and right-handed, or left controlling-eye and left-handed.

Crossed control: the controlling eye and the preferred hand are on opposite sides of the body or no clear preference is indicated: right controlling-eye and left-handed, left controlling-eye and right-handed, or amibdextrous and right or left controlling-eye.

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Corresponding Control in Grade VIII									
1	M	R-R	R-R	R-R	16.6	129	11.3	10.6	.7
2	M	R-R	R-R	M-R	14.5	106	8.3	11.3	-3.0
3	M	R-R	R-M	M-R	17.5	132	11.6	11.4	.2
4	M	L-R	L-R	M-R	16.5	122	9.9	10.7	- .8
5	F	R-R	M-R	R-R	16.7	129	10.9	11.7	- .8
6	M	R-R	R-R	M-M	15.4	112	9.2	10.0	- .8
7	F	R-R	R-R	R-R	16.4	119	10.9	10.7	.2
8	F	L-R	L-R	L-M	14.2	103	8.8	9.1	- .2
9	F	R-R	R-M	M-M	15.8	121	10.3	10.1	.2
10	F	R-R	R-R	R-R	14.9	116	9.1	9.4	- .3
11	F	R-L	R-R	R-R	14.6	110	8.8	9.2	- .4
12	F	R-R	R-M	R-M	13.0	96	9.1	8.1	1.0
13	F	R-R	R-R	R-R	14.3	104	9.5	9.1	.4
14	M	R-R	R-R	R-R	17.5	129	12.0	11.5	.5
15	M	R-L	R-R	R-R	18.3	134	11.8	12.1	- .3
16	F	R-R	R-R	R-R	16.2	125	9.5	10.4	- .9
17	M	L-R	L-R	L-M	16.8	125	10.6	10.9	- .3
18	F	L-R	L-R	L-R	17.2	125	11.2	11.3	- .1
19	M	R-R	R-R	R-M	17.9	130	11.7	15.8	-4.1
20	F	R-R	R-R	R-R	16.1	118	11.4	10.5	.9
21	F	L-R	L-R	M-R	13.8	101	8.8	8.7	.1
22	M	R-R	R-M	R-R	14.9	111	9.4	9.5	- .1
23	M	R-R	R-M	M-R	15.1	116	9.6	9.6	0.0
24	M	L-R	R-R	M-R	14.3	109	9.0	9.0	0.0
25	M	L-R	L-M	L-R	19.8	149	11.5	13.1	-1.6
26	M	L-R	L-R	M-R	17.1	133	10.6	11.0	- .4
27	F	R-R	L-R	M-M	16.1	125	11.2	10.3	.9
28	F	R-R	R-R	R-R	16.4	119	10.6	10.7	- .1
29	F	R-R	R-R	R-M	16.5	127	11.6	10.6	1.0
30	F	R-R	L-R	M-R	16.1	123	11.0	10.3	.7

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Corresponding Control in Grade VIII (con't)									
31	F	L-R	L-R	R-R	16.6	129	10.4	10.6	- .2
32	F	R-R	L-M	M-M	14.3	112	8.8	8.9	- .1
33	M	R-R	M-R	M-R	15.0	117	9.8	9.4	.4
34	M	L-R	L-R	M-M	16.0	118	10.4	10.4	0.0
35	M	R-R	R-R	R-R	15.8	115	9.3	10.3	-1.0
36	M	R-R	R-M	R-R	15.0	113	11.0	9.5	1.5
37	F	L-R	L-M	M-M	17.2	126	11.8	11.3	.5
38	M	R-R	R-R	R-R	16.3	119	11.6	10.6	-1.0
39	M	L-R	L-M	R-R	10.2	75	6.6	6.0	.6
40	F	L-R	L-R	M-M	12.6	95	9.8	7.7	2.1
41	M	M-R	R-R	L-M	15.7	119	9.8	10.0	- .2
42	F	R-R	R-M	R-R	16.6	128	10.1	10.7	- .6
43	F	R-R	R-R	R-M	17.0	126	12.0	11.1	.9
44	F	L-R	L-R	M-M	17.8	134	12.0	11.6	.4
45	F	L-R	L-R	R-M	11.7	91	6.9	7.0	- .1
46	M	R-R	R-R	R-R	14.1	110	9.4	8.8	.6
47	F	R-R	R-R	R-M	15.8	119	11.1	10.1	1.0
48	M	R-M	R-M	R-M	16.3	123	11.4	10.5	.9
49	F	M-M	L-R	M-M	16.8	126	11.6	10.9	.7
50	M	R-R	R-M	R-M	11.8	89	7.9	7.1	.8
51	M	R-R	R-M	R-R	11.6	91	5.5	6.9	- .4
52	M	L-R	L-M	M-M	15.8	122	11.2	10.1	1.1
53	M	M-R	L-R	L-R	13.2	101	7.7	8.1	- .4
54	F	R-R	R-R	R-M	16.7	131	11.0	10.7	.3
55	F	L-R	L-R	M-M	15.0	113	9.9	9.5	.4
56	M	R-R	R-R	R-R	15.4	120	7.9	9.7	-1.8
57	F	L-R	L-R	L-R	15.2	119	11.4	9.6	1.8
58	F	R-R	R-R	R-R	16.3	123	10.1	10.5	- .4
59	F	R-R	R-R	M-M	16.8	123	11.1	11.0	.1
60	F	L-R	R-R	L-M	16.4	124	10.2	10.6	- .4

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Corresponding Control in Grade VIII (con't)									
61	F	R-R	R-R	R-R	13.1	101	10.9	8.0	2.9
62	M	R-R	R-R	R-M	15.1	114	8.1	9.6	-1.5
63	F	R-R	R-R	R-M	15.2	115	9.1	9.7	- .6
64	M	R-R	R-R	R-R	15.9	117	10.6	10.3	.3
65	M	R-R	R-R	R-M	16.0	119	9.8	10.3	- .5
66	F	R-L	R-M	R-M	12.7	96	8.0	7.8	.2
67	F	L-M	L-M	L-M	16.0	121	10.9	10.3	.6
68	F	R-R	R-R	M-M	13.9	109	10.0	8.6	1.6
69	M	R-R	L-R	L-R	17.5	137	11.2	11.3	- .1
70	F	L-R	L-R	M-R	16.3	123	10.4	10.5	- .1
71	M	R-R	R-R	R-R	17.9	134	10.6	11.7	-1.1
72	M	R-R	R-R	L-M	17.1	132	11.6	11.0	.6
73	F	R-R	R-M	R-M	16.6	130	11.4	10.6	.8
74	F	L-R	L-R	L-R	16.1	122	11.2	10.3	.9
75	M	R-R	R-M	R-M	15.4	115	10.0	9.9	.1
76	F	R-L	L-R	R-R	17.5	127	11.6	11.5	.1
77	F	R-R	R-R	R-M	15.5	115	9.4	10.0	- .6
78	M	L-L	L-L	L-L	15.3	119	10.4	9.7	.7
79	M	R-R	R-R	R-R	17.2	134	11.6	11.1	.5
80	F	R-R	R-R	R-R	12.7	97	7.8	7.8	0.0
81	F	L-R	L-R	M-M	17.1	129	10.5	11.1	- .6
82	F	R-R	R-M	R-M	15.3	130	11.2	9.4	1.8
83	M	R-R	R-M	R-R	15.1	118	9.5	9.5	0.0
84	F	R-R	M-R	R-M	19.1	140	11.8	12.7	- .9
85	F	R-R	R-R	R-R	12.6	99	9.3	7.6	1.7
86	M	R-R	R-M	R-M	16.0	116	10.8	10.4	.4
87	M	R-R	R-M	R-R	16.2	122	10.7	10.4	.3
88	M	R-R	R-R	R-R	17.6	129	10.8	11.6	- .8
89	M	R-R	R-R	R-M	13.0	105	9.5	7.8	1.7
90	F	L-R	L-R	L-M	14.5	113	9.0	9.1	- .1

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Corresponding Control in Grade VIII (con't)									
91	M	R-R	R-R	R-R	15.7	120	9.5	10.0	- .5
92	F	R-R	R-R	R-R	15.8	121	10.9	10.1	.8
93	M	R-R	R-M	R-R	17.1	129	10.9	11.1	- .2
94	M	R-R	R-R	R-R	13.6	107	7.5	8.4	- .9
95	F	R-R	R-R	R-M	18.6	136	12.0	12.3	- .3
96	F	R-R	R-R	R-R	10.8	80	7.1	6.5	.6
97	M	L-R	L-R	L-R	14.9	113	10.6	9.4	1.2
98	F	L-R	L-R	L-R	15.5	117	10.6	9.9	.7
99	F	R-R	R-R	R-R	17.6	133	11.6	11.5	.1
100	F	R-R	R-R	R-R	17.6	128	11.8	11.6	.2
101	M	R-R	R-R	R-M	16.8	127	10.7	10.9	- .2
102	M	R-R	R-M	R-R	13.5	101	7.3	8.4	-1.1
103	M	M-R	L-R	L-M	16.8	125	11.1	10.9	.2
104	F	L-R	L-R	L-R	13.6	103	10.1	8.5	1.6
105	F	R-R	R-R	R-R	15.2	111	9.9	9.8	.1
106	M	R-R	R-R	R-R	12.5	94	9.5	7.7	1.8
107	F	L-R	L-R	M-M	17.6	136	12.0	11.4	.6
108	F	R-R	R-M	R-M	16.3	119	10.7	10.6	.1
109	F	R-M	R-R	R-M	14.3	112	11.3	8.9	2.4
110	M	R-R	R-R	R-R	15.5	115	8.6	10.0	-1.4
111	M	R-R	R-M	R-M	14.6	109	10.8	9.3	1.6
112	M	R-M	R-R	R-M	15.3	119	10.9	9.7	1.2
113	M	R-R	R-R	R-M	16.7	129	9.2	10.7	- .5
114	F	R-R	R-R	R-M	14.3	106	8.9	9.1	- .2
115	F	L-R	L-R	L-M	18.1	124	10.4	12.2	-1.8
116	F	R-M	R-R	R-R	13.9	106	9.0	8.7	.3
117	M	R-R	L-R	M-M	14.2	107	9.4	8.9	.5
118	F	R-R	R-R	R-R	14.2	106	10.9	9.0	1.9
119	M	L-M	L-R	L-R	10.7	78	7.3	6.4	.9
120	F	R-M	R-R	R-R	10.7	83	8.5	6.2	2.3

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Corresponding Control in Grade VIII (con't)									
121	F	R-R	R-R	R-M	13.3	100	7.6	8.3	- .7
122	F	L-R	L-R	L-M	14.1	103	9.9	9.0	.9
123	F	L-R	L-R	L-M	15.6	121	10.0	9.9	.1
124	M	L-M	L-R	M-R	15.0	112	10.3	9.6	.7
125	F	R-R	R-R	R-R	13.2	101	8.8	8.1	.7
126	M	R-L	R-R	R-M	15.9	120	11.1	10.2	-1.1
127	M	L-R	L-M	R-R	16.7	126	11.3	10.8	.5
128	F	R-M	R-R	R-M	16.4	119	10.4	10.7	- .3
129	F	R-R	R-R	M-M	16.0	116	10.6	10.4	.2
130	F	R-R	L-R	L-R	13.2	103	9.4	8.1	1.3
131	F	R-R	R-R	R-R	14.4	112	9.7	9.0	.7
132	F	L-R	L-R	L-M	15.2	110	6.9	9.8	-2.9
133	F	R-R	R-R	R-M	13.6	106	9.1	8.4	.7
134	M	R-R	R-R	R-M	17.1	128	11.2	11.1	.1
135	F	R-L	R-R	M-R	15.0	110	10.4	9.6	.8
136	F	L-R	L-R	R-R	14.4	111	7.6	9.0	-1.4
137	M	R-R	R-R	R-R	16.8	126	11.3	10.9	.3
138	F	L-R	L-R	R-R	17.5	132	10.8	11.4	- .6
139	M	L-R	L-R	L-R	16.2	120	10.1	10.5	- .4
140	F	L-R	L-R	M-M	13.9	108	8.9	8.6	.3
141	M	R-R	R-R	R-M	15.4	116	8.1	9.8	-1.7
142	M	R-R	R-R	R-M	17.9	135	10.4	11.7	-1.3
143	F	R-R	R-R	R-R	14.6	106	8.5	9.4	- .9
144	M	R-R	R-R	M-M	16.8	122	8.8	11.0	-2.2
145	F	R-R	R-R	R-R	15.2	112	9.7	9.8	- .1
146	F	M-R	R-R	M-M	13.1	101	8.5	8.0	.5
147	M	R-R	R-R	R-R	16.7	126	11.6	10.8	.8
148	F	R-M	R-R	R-R	15.9	121	11.2	10.2	1.0
149	M	R-R	R-R	R-R	15.5	114	9.1	9.9	- .8
150	F	R-R	R-R	R-R	15.8	122	10.1	10.1	0.0

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Corresponding Control in Grade VIII (con't)									
151	M	R-R	R-M	M-M	15.0	111	11.0	9.6	1.4
152	F	L-L	L-M	L-L	17.1	129	10.0	11.1	-1.1
153	F	L-L	R-L	M-L	13.9	121	9.7	8.7	1.0
154	M	L-L	L-L	M-M	17.1	126	10.5	11.2	- .7
155	F	R-M	R-L	M-M	13.9	108	10.0	8.6	1.4
156	F	L-R	L-L	M-M	15.9	124	10.5	10.1	.4
157	M	M-M	M-M	R-L	14.9	108	9.7	9.6	.1
158	F	L-L	L-M	M-L	16.7	129	11.0	10.7	.3
159	M	R-L	L-L	L-L	16.0	125	10.0	10.2	- .2
160	M	L-L	L-L	L-L	16.1	117	12.0	10.5	1.5
161	F	M-L	L-L	M-L	16.8	128	11.2	10.9	.4
162	M	R-R	R-L	R-L	14.6	108	6.8	9.3	-2.5
163	F	R-L	R-L	L-M	13.7	102	9.0	8.6	.4
164	F	L-L	L-L	M-L	17.8	135	11.8	11.6	.2
165	M	M-L	M-L	L-L	14.1	108	7.3	8.8	- .5
166	F	L-L	L-L	L-M	9.2	63	6.4	5.5	.9
167	F	R-R	R-M	R-M	15.8	116	11.0	10.2	.8
168	F	M-L	M-L	R-L	13.5	102	10.5	8.4	2.1
169	F	R-L	R-M	M-L	16.2	124	11.4	10.4	1.0
170	F	M-L	L-M	M-L	15.6	120	10.2	9.9	.3
171	M	L-R	L-L	R-L	16.5	127	10.4	10.6	- .2
172	F	L-L	L-L	L-L	17.1	134	10.6	11.0	- .4

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Crossed Control in Grade VIII									
173	M	R-R	R-R	R-M	17.8	138	12.0	11.5	.5
174	F	L-R	L-R	L-R	13.1	95	8.9	8.2	.7
175	F	M-R	R-R	M-R	16.1	126	10.3	10.2	.1
176	M	M-M	M-L	M-L	15.7	117	10.2	10.1	.1
177	F	L-R	L-R	M-M	17.9	130	10.2	11.8	-1.6
178	M	R-L	R-R	R-M	14.5	111	10.4	9.1	1.3
179	M	L-R	L-R	L-R	15.5	115	11.6	10.0	1.6
180	F	L-R	R-R	R-M	15.5	115	10.7	10.0	.7
181	F	R-R	R-M	R-R	15.4	112	9.6	10.0	- .4
182	F	R-R	R-R	R-M	14.9	115	8.8	9.4	- .8
183	M	R-R	R-M	R-R	14.7	108	9.9	9.4	.5
184	F	R-R	R-R	R-M	14.3	112	8.8	8.9	- .1
185	F	R-R	R-R	R-M	10.2	78	7.8	5.9	1.9
186	F	R-R	R-M	R-R	15.4	117	9.1	9.8	- .3
187	F	L-R	R-R	R-M	17.4	132	12.0	11.3	.7
188	F	R-R	R-R	R-M	16.5	127	9.0	10.6	-1.6
189	F	L-R	L-R	L-R	16.5	119	10.1	10.8	- .7
190	F	L-L	L-M	L-M	14.4	106	8.5	9.2	- .7
191	M	R-R	R-R	R-M	15.4	113	10.4	9.9	.5
192	F	M-L	L-L	R-L	14.1	107	9.7	8.8	.9
193	M	L-R	L-R	L-M	16.8	125	11.9	10.9	1.0
194	M	M-R	L-R	L-R	16.9	123	10.4	11.1	- .7
195	M	L-L	L-M	M-R	11.9	91	8.4	7.2	1.2
196	F	M-R	R-R	R-R	11.5	88	8.5	6.9	1.6
197	M	L-R	L-R	L-M	15.4	112	11.6	10.0	1.6
198	M	L-R	L-R	L-R	16.3	125	11.3	10.5	.8
199	F	L-R	L-R	L-M	12.7	98	7.5	7.7	- .2
200	M	M-R	L-R	M-M	15.7	119	11.6	10.0	1.6

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Crossed Control in Grade VIII (con't)									
201	M	L-R	L-R	L-M	15.0	113	10.5	9.5	1.0
202	M	L-R	L-M	L-L	17.8	137	11.3	11.6	- .3
203	F	M-R	R-R	R-M	16.5	125	11.2	10.6	.6
204	M	L-R	L-R	L-R	13.7	101	7.7	8.6	- .9
205	M	R-R	R-R	R-M	14.1	104	8.5	8.9	- .4
206	F	R-L	R-L	R-M	14.8	111	10.1	9.4	.7
207	M	R-R	R-R	R-R	17.5	129	12.0	11.5	.5
208	M	L-R	L-R	R-L	16.6	123	10.1	10.8	- .7
209	M	L-R	L-R	M-R	15.9	119	10.5	10.2	.3
210	F	L-R	L-R	L-R	11.1	89	5.4	6.6	-1.2
211	F	L-R	M-R	L-M	15.3	114	9.8	9.8	0.0
212	M	R-R	R-R	R-M	16.6	125	11.4	10.7	.7
213	M	L-R	L-R	L-M	14.5	111	9.3	9.1	.2
214	F	L-R	L-R	L-M	14.7	115	9.8	9.2	.6
215	F	R-R	R-R	M-M	15.5	116	10.1	9.9	.2
216	M	L-R	L-R	L-M	15.9	119	11.0	10.2	.8
217	F	R-R	R-R	L-R	17.1	125	11.5	11.2	.3
218	F	R-R	R-R	R-R	15.2	111	9.7	9.8	- .1
219	F	R-R	R-R	L-R	14.4	113	10.1	9.0	1.1
220	M	R-R	R-M	R-M	14.7	108	7.3	9.4	-2.1
221	M	R-R	R-R	R-M	15.2	119	7.7	9.6	-1.9
222	F	R-R	R-R	M-R	15.3	118	10.4	9.7	.7
223	M	R-R	R-R	R-R	14.5	111	9.4	9.1	.3
224	F	R-R	R-R	M-R	16.4	122	11.2	10.6	.6
225	F	R-R	R-R	R-M	15.0	116	9.4	9.5	- .1
226	F	R-R	R-R	R-R	16.8	123	11.2	11.0	.2
227	M	L-R	L-M	L-R	12.7	95	8.6	7.8	.8
228	M	R-R	R-R	R-M	15.4	113	10.4	9.9	.5
229	M	M-R	R-R	R-R	16.2	122	11.0	10.4	.6
230	M	R-M	R-M	R-R	12.3	105	8.5	7.1	1.4

2

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Crossed Control in Grade VIII (con't)									
231	M	L-R	L-R	L-M	13.8	105	9.3	8.6	.7
232	F	L-R	L-R	L-R	12.7	96	8.9	7.8	1.1
233	F	L-R	L-M	L-R	12.8	98	10.1	7.8	2.3
234	F	L-R	L-R	L-M	13.4	102	5.6	8.3	-2.7
235	M	R-R	R-R	R-M	11.6	91	8.8	6.9	1.9
236	M	R-R	R-R	R-M	14.0	107	5.7	8.7	-3.0
237	F	R-R	R-R	R-R	15.4	116	10.4	9.8	.6
238	M	R-R	R-R	M-M	15.4	120	10.8	9.7	1.1
239	F	L-R	L-R	L-M	15.1	110	11.2	9.7	1.5
240	F	R-R	R-R	R-R	13.9	102	10.5	8.8	1.7
241	M	L-R	L-R	L-R	17.0	130	11.4	11.0	.4
242	F	R-M	R-R	R-M	14.7	108	8.5	9.4	- .9
243	M	R-R	R-R	M-M	13.9	102	9.6	8.8	.6
244	M	M-R	R-M	R-R	11.3	89	7.5	6.6	.9
245	M	L-R	L-R	M-M	13.8	105	8.9	8.6	.3
246	F	L-R	R-R	L-L	16.5	127	9.6	10.6	-1.0
247	M	R-R	R-R	R-R	12.3	92	8.5	7.5	1.0
248	F	R-R	R-R	R-M	16.3	122	10.5	10.5	0.0
249	F	R-R	R-R	R-R	15.4	119	9.8	9.8	0.0
250	M	L-M	L-R	L-R	17.2	133	11.2	11.1	.1
251	M	R-M	R-M	R-M	14.8	109	8.8	8.8	-1.1
252	M	L-R	L-R	L-M	16.0	120	10.5	10.3	.2
253	F	L-L	L-R	L-M	14.0	105	9.8	8.8	1.0
254	F	R-R	R-R	R-R	13.4	101	9.0	8.3	.7
255	M	R-R	R-R	R-M	15.3	111	9.4	9.9	- .5
256	F	R-R	R-R	L-R	13.4	103	8.7	8.3	.4
257	F	R-R	M-R	M-M	12.1	89	8.4	7.2	1.2
258	F	M-R	R-R	R-R	12.7	96	8.7	7.8	.9
259	F	M-R	R-M	R-M	11.6	87	7.3	7.0	.3
260	F	L-R	L-R	R-M	16.5	122	11.2	10.7	.5

DATA

No.	Sex	Kdgn. Eye-Hand Dom.	Gd. 2 Eye-Hand Dom.	Gd. 8 Eye-Hand Dom.	M.A.	I.Q.	Total Rdg. Ach.	Rdg. Exp.	Rdg. Diff.
Subjects Exhibiting Crossed Control in Grade VIII (con't)									
261	F	L-R	L-R	L-R	16.6	130	11.2	10.6	.6
262	F	R-R	R-M	R-M	11.3	84	7.9	6.8	1.1
263	F	R-R	L-R	R-M	13.2	110	8.7	7.9	.8
264	F	L-L	R-R	M-L	15.6	122	10.4	9.9	.5
265	M	M-R	L-R	L-R	16.5	128	9.8	10.6	- .8
266	M	R-M	M-M	R-M	13.6	104	10.0	8.4	1.6
267	F	R-R	R-R	M-M	16.3	120	9.8	10.6	- .8
268	F	R-R	R-M	M-M	15.9	117	11.6	10.3	1.3
269	F	R-M	R-R	L-M	16.5	127	10.3	10.6	- .3
270	M	R-R	R-R	R-M	13.6	106	5.8	8.4	-2.6
271	M	L-R	L-R	R-M	19.0	139	11.9	12.9	-1.0
272	M	L-R	L-R	L-M	17.0	126	12.0	11.1	.9
273	F	R-R	R-R	R-M	13.6	107	9.7	8.4	1.3
Subjects Exhibiting Visual Problems in Grade VIII									
274	F	L-R	L-R	L-R	13.9	108	10.2	8.6	1.6
275	F	R-R	R-R	L-M	12.2	90	9.1	7.5	1.6
276	F	L-R	L-R	L-R	13.1	103	7.9	8.0	- .1
277	M	L-L	L-L	L-L	10.1	76	4.9	5.9	-1.0

Handedness Test
(45 Seconds)

Name _____

Hand _____

Practice:

Begin: